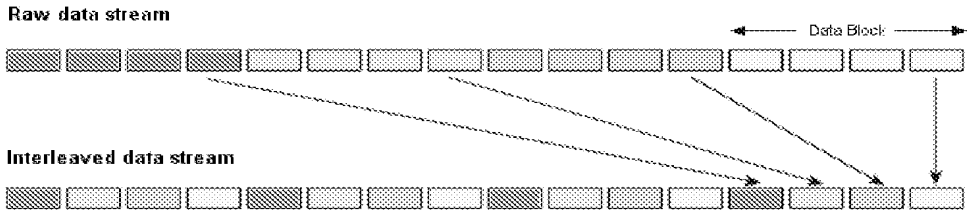
Interleaving Explained

Traditionally adsl used what is known as "FAST" method for transmitting data.
MaxDSL & LLU can make use of a technology called Interleaving to help maintain the tolerance against noise on longer length lines.

If during transit more than a certain amount of data has been lost then the data cannot be correctly decoded by your router. Short bursts of noise on the line can cause these data packets to become corrupt and the modem has to re-request data which in turn can slow down the overall rate at which data is transmitted.

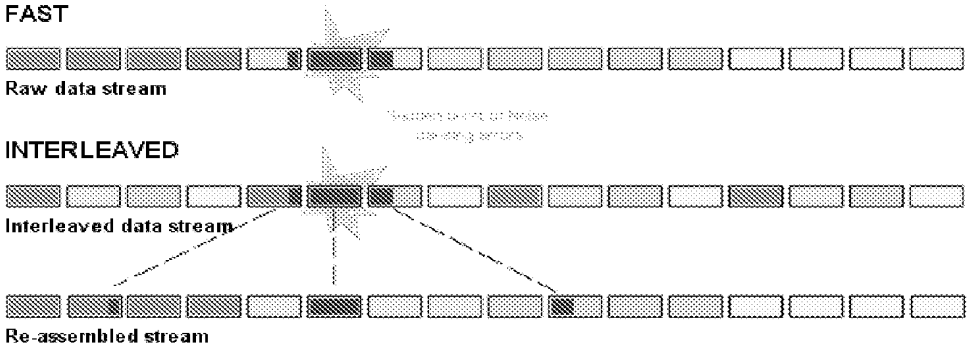
Interleaving is a method of taking data packets, chopping them up into smaller bits and then rearranging them so that once contiguous data is now spaced further apart into a non continuous stream. Data packets are re-assembled by your modem.
The diagram below is an example of how interleaved traffic is transmitted.



When adsl data packets are transmitted they contain additional control bits that enable your modem/router to check and correct a certain amount of erroneous bits. This type of error checking is known as FEC or Forward Error Correction.

If your line is particularly susceptible to bursts of noise then interleaving should improve your adsl experience simply because if you lose a whole batch of data then this could cause your modem to loose sync with the exchange.

We can see in the diagram below what effect bursts of noise can have on packets that are being transmitted. Using the more traditional FAST method, the modem would not be able to interpret the data and the information would have to be re-requested, or even worse, your connection could drop.



Using Interleaving, the modem is able to re-assemble the data or if necessary just re-request the part of the data that it is unable to recover. By improving the efficiency of the error detection and correction correction codes, BT state that interleaving has been "shown to significantly improve error performance and stability of marginal lines".

By now you may be asking if interleaving is so good, then why isn't it used by default?
The answer to that is that it can also have a downside - chopping up, rearranging and decoding of the data adds a small amount of additional time it takes for data transmission. Forward Error Correction will also add to the delay, since the check bytes will take additional transmission time.

BT state that interleaving can increase latency by an additional 20-40ms. Whilst this will not be noticeable to the vast majority of users, ardent gamers are the ones most likely to complain about additional latency and therefore prefer a slower synch speed than higher latency.

It should also be pointed out that whilst BTw state that applying interleaving shouldn't reduce your line speed, it does reduce the maximum line rate achievable from 8128kbps to 7616kbps due to the additional overhead required for check bytes.
Note: although BT state 7616 is maximum sync speed with interleaving, many instances of higher sync speeds have been reported by users. This is dependent upon your router being able to support S=1/2 mode which effectively combines two RS code words into a larger logical code word of 510 bytes (ANSI T1.413).

Interleaving and Error Correction are always switched on at the same time and the 7616 profile has a 512kbps error correction overhead with an increased latency of around 16 ms.

Interleaving is set to "auto" by default and interleaving is then controlled by the DLM process, turning it on if needed. It is possible to arrange to have interleaving set to permanently "on" or "off" via your ISP. Some ISPs may make a charge for doing this.

~ Interleave Depth

- Interleave Depth defines the number of bits (or bytes) in each block of data, for example my diagram above shoes an example Interleaving depth of 4.
- ADSL supports a various levels of interleaving, the depth of which can range from 1 (no interleaving) to 64.
- Steps Ive seen are 4, 8, 16, 32, 64 for the downstream and 2, 4, 8 for the upstream.
- BTw makes little mention of Interleave Depth, and this would appear to be something that is controlled entirely by the DLM as there certainly are various depths of interleaving applied by the system.
- Some LLU providers have configurable Interleaving Depths and will change your profile upon request.
- Some routers will show you the depth of Interleaving applied to your line
  eg: *D (interleaver depth) 32 4*

~ Interleave Delay

- Interleave Delay defines the mapping (relative spacing) between subsequent input bytes at the interleave input and their placement in the bit stream at the interleave output.
- For example, in my diagram this would be the time between say 2 yellow boxes.
- Some routers will show the interleave delay in ms.

~ Maximum Interleave Delay:

- Configurable attribute on some dslams/routers as the maximum time for the Interleave Delay. - The higher the Interleave Delay the greater the Interleaving Depth.
- Some LLU providers (such as Sky) will configure this figure upon request

~ Latency

- It is important to note that Interleave Depth & Interleave Delay do not appear to be the same thing as the additional amount of latency you will see when interleaving is switched on.
- Nor is latency affected by connection speed -eg it does not decrease when you go from 1Mb to 2Mb.